Questions answered September 27, 2000

1. For both the upwind and downwind cases, the tip pitch angle is identified as 3.0 deg. Does this mean that the physical blade pitch relative to the hub was unchanged? Or is there a change in sign convention between upwind and downwind?.

   The blade tip pitch angle measurement convention is relative to the wind direction as shown in Figure 3 of the Blind Comparison Overview. The blades were detached from the turbine, rotated 180 degrees, and reattached to the turbine during the transition from the downwind turbine configuration to the upwind configuration. Thus the physical blade pitch relative to the hub changed, but the sign convention remained unchanged.

Questions answered September 21, 2000

1. We are unsure whether the moment arm for the nacelle yawing moment should be 1.401 m or 1.469 m, because we are unsure of the load path on the basis of the diagram alone.

   In Figure A.1 of the Machine Data document, the dimension 1.401 m refers to the distance from the yaw axis to the blade axis. The dimension 1.469 m refers to the distance from the yaw axis to the teeter pin which is the load path. However, the yaw moment arm would be the distance from the center of rotation to a point on the blade. Note also that the load paths are described in the Loads Analysis document.

2. is it possible to have data, which are given in tables, on files? Firstly I'm thinking of tables A.1- A.9.

   In Adobe Acrobat, using the select text button, you can copy the text in the tables. Paste it into a text editor. Then open the text file in Excel as a space delimited file. I would send the Word document that was used to create the *.pdf, but it is 65 MB.

3. what about blade properties at the tip, refering to table A.9

   The mass and stiffness distribution of the tapered, twisted blades used for the wind tunnel test was not available. The old constant-chord, twisted blades used in a previous phase of the experiment (field testing only) were made by the same manufacturer, and the estimates of mass and stiffness distribution for these old blades is shown in Table A.9. The modal properties of the old blades are also provided with the intent that participants can modify the mass and stiffness distribution for the old blades to estimate that of the new blades. The tip properties are included in the table A.9 to the best of our knowledge. The standard tip (not the smoke tip, tip plate, or blade extension) was used for the conditions in the code comparison.

4. more details about the blade modal frequencies, as support clamping conditions and blade length at the modal test (page A-12)

    Figure A-4 was added after the invitation was sent. It illustrates the bearing locations that hold the pitch shaft. The modal test for the blade alone was performed with clamps in the same location as the bearings that hold the pitch shaft in the hub. The blade length should have been 5.029 m for the modal test as it was when mounted to the hub.

5. on page A-13 rotor inertia is given as 949 kgm2. Is that comparable with given turbine mass distribution?

    The rotor inertia refers to the blades, hub, boom, camera, and instrumentation enclosures which weighed 576.3 kg. The blade mass distribution in Table A-9 refers to the constant-chord, twisted blades used in Phase V of the experiment. They weighed 70 kg while the blades used in the wind tunnel test weighed 60 kg. This difference is probably due to the root mounted camera (13 kg distributed evenly from 0.508 m to 1.006 m) which was not used in the wind tunnel test. The derivation of the rotor inertia is explained on pages A-14 and A-15.

6. tower inner diameter (Page A-19) at least seems to be wrong. Based on given tower material the thickness (19 mm) calculated tower mass is more close to given 3317 kg. What is the thickness distribution along the tower? Is the Semi span mount included in the mass figure?

    On page A-19, the number listed as tower inner diameter is actually the wall thickness. The thickness for each tower section is constant, and the thickness of the conical section is 0.0124m. The mass listed is of the tower alone. The semi-span mount was not weighed.

7. around what point (cg or tower top) is nacelle + hub + boom inertia 3789 kgm2 given? (Page A-19)

    The inertia of the nacelle, hub, and boom was translated to the yaw axis.

8. does first tower frequency 1.695 Hz include nacelle, hub and rotor? (Page A-19). The figure cannot be found among given modal frequencies.

    This frequency represents the nacelle, hub and rotor. It was obtained by shaking the turbine by hand and timing 20 cycles. This frequency falls between two frequencies obtained with the modal test (Table A.15). Possibly, shaking the turbine by hand excited a diagonal tower mode combination of the two that were captured with the modal test. We probably should remove 1.695 Hz from the information provided.

9. due to fact that there are a lot of eigenfrequencies lower that 10p, dynamic influencies can be important parts of measured loads. Is that what have you experienced?

    The emphasis of this exercise is the aerodynamic quantities predicted with the models. The blades were designed to be stiff to mitigate aero-elastic responses. While cyclic predictions of root bending moment may vary greatly, we will probably only look at mean values. The aerodynamic quantities will be studied as a function of azimuth angle, and we do not believe that blade dynamics strongly influence our measured aerodynamic quantities.

10. the more important the dynamics are the more information about stiffnesses as yaw bearing, nacelle structure and primary shaft bending is needed. Are there more detailed drawings available?

    Again, the emphasis of this exercise is the aerodynamic quantities predicted with the models. An additional document has been added to the website (under the Loads and Stress Analysis documents) that details the new yaw shaft, yaw drive, and yaw brake mechanisms. A more detailed drawing of the nacelle and components can be found under the low-speed shaft strain gage section of the Instrumentation Specification document.

11. is it possible for you to describe the modes in terms of dominating components and how they are related (in phase or out of phase) to each other?

    The movies were provided to illustrate the modes due to the complexity. We started to identify the modes as suggested, but due to the complexity, we thought it would be best to leave it up to the modelers.

12. Is it possible to have measured modes (table A.15 – A.17) as files of time series and/or FFT curves?

    The website has been updated with the modal test report and some Excel files that contains the results obtained by the contractor who performed the test. Frequency response functions are included.

13. Were the test conditions all run with the same blades? and if so which one(s)? Were the profiles always S809?

    All wind tunnel test data was obtained using the tapered, twisted blades. The blind comparison test points used the standard blade length (5.029 m) with the standard tip piece (not the smoke tip, tip plate or blade extension). The profiles are always S809.